S&A FY03 ANNUAL REVIEW MEETING



A System for Measurement of Energy Use in Industrial Heating Applications

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Project Overview



Project description

 A versatile, low-cost Energy Management Device (EMD) for industrial combustion processes used in Small Business'

Objectives

- Integrate multiple sensors, calculate and report process efficiency
- Develop a hybrid energy-balance process model that can be readily adapted by users to many different combustion processes
- Using a combination of non-intrusive direct and indirect measurements, provide operator and management feedback on process efficiency as well as changes in efficiency
- Provide capability to integrate with higher level controls

Overall goal

Offer a general purpose EMD for under \$1000 in volume

Technical Merit



- Addresses technical need(s) of the S/C community and the S/C priorities of the IOFs
 - Small IOF Businesses are a major consumer of energy resources
 - Their combustion processes run the gamut from boilers, heat exchangers, distillation columns, to specialized heat treating furnaces
 - Unlike major manufacturing plants, they cannot afford tools to assess energy consumption and efficiency nor do they employ the technical resources to develop their own.
 - EMD will bring an affordable tool that virtually any Small IOF Business can afford and use

Technical Merit

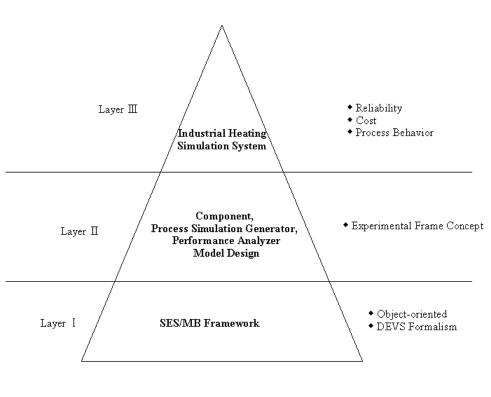


Contributes new information or technology to the S/C community

- Hybrid modeling of many industrial combustion processes leading to a robust energy-balance process model developed in conjunction with Cleveland State University
- The commercial key is "scaling" expensive, existing technology to fit a specific blue-collar, Small Business requirement
 - Utility generator plants often pay upwards of \$250,000 for a complete Performance Calculation System
 - EMD's Target cost complete \$1000
- WRC is applying our embedded computer, communications, I/O, and signal conditioning technology to provide a broad-based, lowcost device

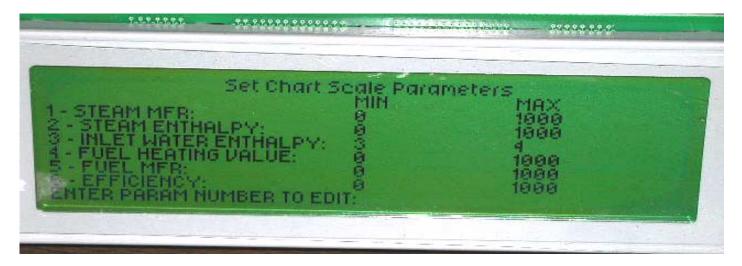


An approach defined with **Cleveland State University for** library of common thermal process simulations to evolve hybrid energy-balance model. This is combined with on-line "production results" to yield "efficiency"





Base operating system, operation, and display system developed



• Generalizing "Production Results" needs attention



Data storage and compaction algorithm developed



Future EMD



From this to this!





Future EMD



Target package has been defined

- Smaller for acceptance and lower cost
- Requires new Universal I/O circuitry
- Requires costreduction
- Addition ofWireless EthernetWeb Server





- The Universal Sensor Input Circuit concept has been defined.
 - Biggest issue will be finalizing termination arrangement
 - Must handle
 - all thermocouples with CJC
 - variety of RTDs
 - 0-20, 4-20 mA
 - 0-10 V and any range within
 - Additional inputs for "production results" will be addressed



- The embedded, wireless web-server concept has been defined and possible hardware identified
 - Advantages:
 - any PC in the plant will be able to check on process efficiency
 - Both management and plant operators will have access using standard browsers
 - Expanded detail will be available
 - Challenges:
 - embedded web server is different from PC hosted servers
 - It has been done, we just have to bootstrap ourselves
 - cost (memory) constraints
 - DeviceNet interface maintained migration path to higher level systems



What is DeviceNet and why is it important?

- Advantages:
 - Open Architecture communications ODVA
 - Virtually all major PLC manufacturers support it
 - Most DCS manufacturers support it
 - Virtually all industrial software vendors support it
 - Hardware and operations are standardized
 - I/O software structures are standardized
 - I/O structures are inherited through higher level Ethernet-IP
 - provides seamless software from the enterprise down to the sensor
 - Inexpensive
 - WRC was one of the original industry team partners



Confirmed target price can be achieved

EMD Cost Analysis based on W	/RC1 implement	ation			
Course at Duadout Dulaina					
Current Product Pricing WRC1-JDA-1	1	\$	480.00	\$	48
1781-PS4	1	\$	65.00	\$	- 40
1781-PS4 1781-7B08		\$	200.00	\$	20
WRC7-32-01	1	\$		\$	
	8		45.00		36
1781-C7x	1	\$	35.00	\$	3
Enclosure	1	\$	85.00	\$	3
Assembly Labor	5	\$	60.00	\$	30
Display	1	\$	150.00	\$	15
Keypad	1	\$	65.00	\$	6
EMD Software	1	\$	250.00	\$	25
Today's Price				\$	1,99
Adjustments					
Base Price				\$	1,99
Replace WRC1 metal				-	-,
packaging with molded					
case and integral					
terminations				\$	
Replace WRC1 0-10V				Ψ	
analog inputs with					
universal analog inputs	8	\$	5.00	\$	_
Delete WRC7 modules.		Ψ	0.00	Ψ	
mounting board and					
cable				\$	
1781-7B08	-1	\$	200.00	\$	(20
WRC7-32-01	-1	\$	45.00	\$	(36
1781-C7x	-o -1	\$ \$	35.00	\$	(30
Delete Enclosure and	-1	Ψ	35.00	Ф	(3
				_	
Assembly Labor		•	05.00	\$,,
Enclosure	-1	\$	85.00	\$	(8
Assembly Labor	-5	\$	60.00	\$	(30
Expand Memory, add					
ethernet, faster					
microprocessor	1	\$	50.00	\$	
Cost Reduce Display	-0.5	\$	150.00	\$	(7
Purchase Keypad in					
volume	-0.5	\$	65.00	\$	(3
Target Price				\$	99



- Non-invasive fuel-flow sensor investigation was abandoned
- Fixed frequency laser sensor for exhaust gas O₂ will be explored
 - must be low-cost
 - optics and sighting mechanism must be simple
 - If feasible, would be an invaluable extension to the EMD
 - much tighter control of fuel-air ratio
 - much tighter control of pollutants and exhaust gases



Future Technical Milestones/Goals

Milestone/Goal	Expected Completion Date	Comments
Library - Process Simulations	July '04	CSU assist
Energy-Balance Model	Sept '04	multiple processes
Cost reduce package & hard	Sept '04	to reach target
Wireless HTTP Server	Sept '04	expands market
Field Trials	April '05	6 IOF sites
Project Completion	June '05	Pre-Production



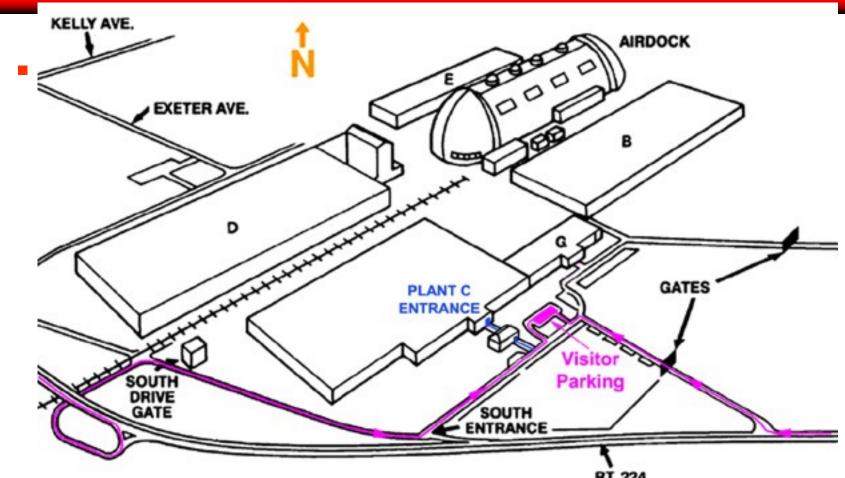
Expected progress toward milestones/goals

- Phase I goal of an emulator postponed until Phase II since Lockheed Boilers were made available
- Phase I goal of fuel-flow sensor was determined not feasible. Will explore low-cost exhaust gas analyzer during Phase II

Possible barriers

- Ability to characterize simulations for broad array of processes prior to field trials
- Cost targets are a challenge





Lockheed Martin - Naval Electronics & Surveillance Akron, Oh, Secured Military Site



Industrial end-user involvement



Lockheed Martin - Naval Electronics & Surveillance Akron, Oh



Industrial end-user involvement



Lockheed Martin - Naval Electronics & Surveillance Akron, Oh

Market Potential



Commercialization plan

- Three-pronged approach
 - Develop an exclusive relationship to market the EMD through a large controls company such as Rockwell Automation or Rosemont Emerson Analytical
 - WRC's involvement with Rockwell's Encompass Program
 - WRC has explored the potential with Emerson.
 - or WRC to market the product through our distribution network
 - http://www.wrcakron.com/dist.html/
 - or Brand-label for smaller, more focused process/energy organizations like Novaspect
 - http://www.novaspect.com

Market Potential



Other IOF areas of applicability

- Initial process supported is boiler operation cuts across all IOFs
- In addition to boilers, processes to add include:
 - heat exchangers
 - reheat furnaces
 - heat treating furnaces
 - annealing furnaces
- One or more of these processes are used throughout all IOFs

Market Potential

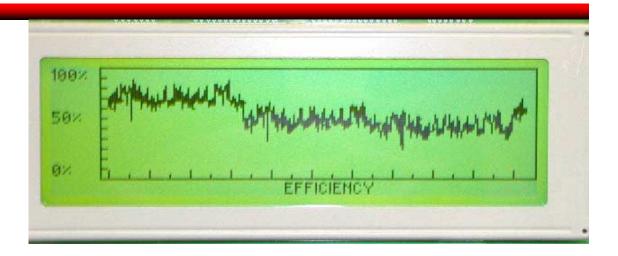


After OIT project completion, what's next?

- Discussions with potential marketing partners confirms that a significant market exists even though this has not been quantified or independently assessed
- General agreement that the version with a wireless, embedded web server will generate the most interest
- General agreement that the DeviceNet Interface will sell to growing companies
- Due to the extensive variety of combustion processes, ongoing application development will be required to expand and fine-tune the hybrid energy-balance process model
- A team of application support engineers will be required to support new installations as well as field expansions

Programmatic Merit





Energy benefits

- Using actual history as a guide
 - Daily efficiency swings of 10 20%
 - 5-year decline of 10%
 - With on-line, real-time process efficiency monitoring we anticipate cutting those swings to 5% - 10%
 - With historical perspective reverse decline
 - With an annual gas bill ~ \$1,000,000 we expect anticipate savings approaching \$75,000

Programmatic Merit



Economic and environmental benefits

- Anticipate energy savings of 5% to 10% annually
- Improved efficiency will minimize pollution and greenhouse gases
- Small IOF Businesses will be able to compete more effectively at home and abroad
- Low capital investment by Small IOF Businesses means this is technically and commercially practical

Summary



- Design with one process has been completed
- Field trial is just commencing
- Confident we will demonstrate real savings ~ 5 to 10%
- Financial analysis confirms we can meet the \$1000 target
- Plan with CSU for library of process simulations to evolve general purpose, energy-balance model is in place
- Discussions with potential marketing partners confident the market exists